Passive Transport Lab

In this experiment you will examine **how well a material called dialysis tubing models the actions of a selectively-permeable cell membrane**. The tubing will be filled like a balloon with a solution containing all the substances below.

Pre-Lab:

1. Explain why this material can simulate passive transport mechanisms but not active transport mechanisms.

2. Read the information on "Indicators" on the following page. Fill in the data table below using this information.

3. Read the methods & analysis details to construct a data table for recording data on lab day.

Substance	Can the substance move across a cell membrane passively?	How can I test if the substance crossed the dialysis tubing?
Starch		
Glucose		
Fats		
Salt		
Protein		
Water		* Hint – you can use a scale/balance

What are Indicators?

Indicators are chemicals that help identify the composition of an unknown material.

In food analysis, indicators are used to detect the presence of specific organic or inorganic compounds such as sugars, proteins, starch, lipids, or salts.

Indicators can be used to perform qualitative analyses which are designed to determine the type (quality) of an unknown substance being tested . Indicators can also be used, in conjunction with appropriate techniques, to perform quantitative analyses which are designed to determine the amount (quantity) of unknown substance being tested. In this exercise we will do only qualitative tests.

Qualitative Analyses

Note: Glucose test-strips may be available instead; otherwise, teacher will provide additional instructions for Benedict's test.

Benedict's test for simple sugars:

Benedict's reagent contains blue copper (II) sulfate ($CuSO_4$) which is reduced to red copper (I) oxide (Cu_2O). The copper oxide is insoluble in water and precipitates out of solution. The color of the final solution may appear green to brick red depending on how many of the copper (II) ions are present.

Lugol's Iodine (IKI) test for the presence of starch:

Iodine dissolved in an aqueous solution of potassium iodide - reacts with starch producing a deep blue-black color. This reaction is the result of the formation of polyiodide chains from the reaction of starch and iodine. The amylose, or straight chain portion of starch, causes the dark blue/black color. The amylopectin, or branched portion of starch, causes the formation of an orange/yellow hue.

When starch is broken down or hydrolyzed into smaller carbohydrate units, the blue-black color is not produced. The iodine solution will also react with glycogen and cellulose, although the color produced is more brown and much less intense.

The Sudan IV test for the presence of lipids:

Sudan IV ($C_{24}H_{20}N_4O$) is a red, fat-soluble dye used for staining lipids, triglycerides and lipoproteins.

Staining is an important chemical technique, offering the ability to visually qualify the presence of the fatty compound of interest without isolating it.

The Biuret test for the presence of proteins:

Biuret reagent, made of sodium hydroxide and copper (II) sulfate, is used for determining the presence of protein in a sample. The test relies on the reaction between copper ions and peptide bonds in an alkaline solution.

A violet color indicates the presence of proteins. Proteins give a strong Biuret reaction because they contain a large number of peptide bonds.

The blue reagent changes to pink when combined with short-chain polypeptides which contain smaller numbers of peptide bonds.

The silver nitrate test for salt (sodium chloride – NaCl):

Silver nitrate is a chemical compound with chemical formula $AgNO_3$. It is one of the light-sensitive ingredients in photographic film and is a corrosive compound. Soluble silver salts tend to be very toxic to bacteria and other life forms.

To detect the presence of chloride (Cl^-) in water (from NaCl or any other source), silver nitrate is added. White silver chloride crystals will form if chloride is present:

$Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$

Silver chloride crystals become visible because they are insoluble in water.

The basic methods should be as follows:

1. Fill a piece of tubing with the substance provided.
2. Perform any necessary initial measurements (weighing, etc.)
3. Place tubing into a beaker of **pure water** & wait 30 minutes.
4. If weighing, dry off outside of tube first!
5. Mix the beaker liquid gently but thoroughly.
6. Take a small sample of liquid from the beaker and place into a test tube.
7. Perform your first indicator test, record results & dispose of sample.
8. Perform all other indicator tests in the same manner, being careful not to do more than 1 indicator test on a single sample.

Based on your knowledge of substance membrane permeability, you will determine whether each substance **will** or **will not** cross the tubing passively in the same fashion as a true membrane. You will collect data for all groups and set up an expected vs. observed table for a chi square analysis. All groups need to reach a consensus about expected decisions. For example if all 5 groups think protein will cross the membrane, your expected value will be 5. If 2 out of 5 groups think it won't cross the membrane, all groups must reconvene and come to a consensus.

Analyze your data using the chi square test and construct a figure that best models this data, including error bars from a calculated standard error.
Construct your lab report as per the standard guidelines. Principles of concentration gradient, membrane permeability, water potential, osmosis, diffusion & passive transport must be addressed in the report.